

# Alien terrestrial crustaceans (Isopods and Amphipods) Chapter 7.1

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## Abstract

A total of 17 terrestrial crustacean species aliens to Europe of which 13 isopods (woodlice) and 4 amphipods (lawn shrimps) have established on the continent. In addition, 21 species native to Europe were introduced in a European region to which they are not native. The establishment of alien crustacean species in Europe slowly increased during the 20<sup>th</sup> century without any marked changes during the recent decades. Almost all species alien to Europe originate from sub-tropical or tropical areas. Most of the initial introductions were recorded in greenhouses, botanical gardens and urban parks, probably associated with passive transport of soil, plants or compost. Alien woodlice are still confined to urban habitats. Natural habitats have only been colonized by three amphipod species in the family Talitridae.

## Keywords

Woodlice, lawns shrimps, Europe, alien

## 7.1.1. Introduction

The orders in the arthropod subphylum Crustacea are mainly composed of aquatic-living species, at least during part of their life-cycle. Most alien terrestrial crustaceans belong to the order Isopoda, suborder Oniscidea, commonly named woodlice. But

several species recorded in Europe belong to the order Amphipoda, and are commonly known as “lawn shrimps” or “landhoppers”.

In 2004, the total number of valid Isopod species worldwide was 3637 (Schmalfuss 2003). Woodlice are adapted to various terrestrial environments from sea shores to deserts and have established on all continents. As decomposers of organic plant material, isopods play an important role in ecosystems (Holthuis et al. 1987, Zimmer 2002). Most European species prefer humid and moist micro-habitats (Vandel 1960) like soil, leaf litter, mosses and decaying wood. Several species are known for their myrmecophylic nature.

Amphipods are generally marine or limnicolous, and only a few species can live permanently on land (mainly in the family Talitridae). Some live near the sea, on beaches where they hide under logs and dead algae and vegetation. The true terrestrial amphipods live on the surface of mulch and moist ground (Fasulo 2008). Many of the habitat features of terrestrial amphipods are similar to those of isopods. These little animals are most commonly noticed by their strong, rapid jumps upon being disturbed.

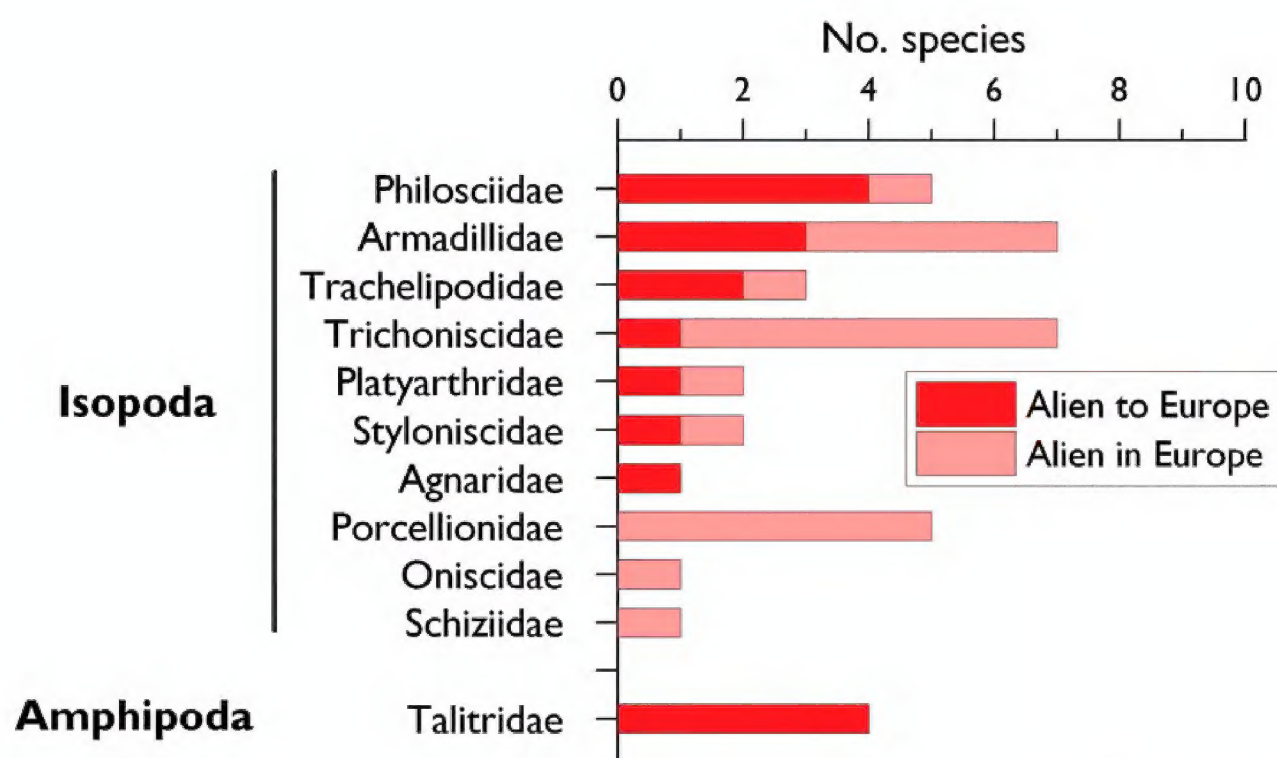
### 7.1.2. Taxonomy of alien terrestrial crustaceans

Thirty-eight species belonging to ten different families were recorded during this study. The four most commonly represented families (all belonging to Isopoda) are Trichoniscidae (seven species), Porcellionidae (five species), Philosciidae and Armadillidiidae, both with five species (Figure 7.1.1.). Two main categories were considered:

- Aliens *to* Europe, including 17 crustacean species originating from other continents (Table 7.1.1).
- Aliens *in* Europe, represented by 21 crustacean species native to a region of Europe but introduced in another European region to which they are not native. Several other species considered as cryptogenic or cosmopolitan are probably also aliens in some parts of Europe. However, in most cases it was not possible to distinguish their alien range from the native one. Below only those species we classify as aliens *in* Europe:

Armadillidiidae: *Armadillidium assimile* Budde-Lund, 1879, *Armadillidium kosuthi* Arcangeli, 1929, *Armadillidium nasatum* Budde-Lund, 1885, *Armadillidium vulgare* (Latreille, 1804);

- Oniscidae: *Oniscus asellus* Linnaeus, 1758;
- Philosciidae: *Chaetophiloscia cellaria* (Dollfus, 1884);
- Platyarthridae: *Platyarthrus schoblii* Budde-Lund, 1885;
- Porcellionidae: *Porcellio dilatatus* Brandt, 1833, *Porcellio laevis* Latreille, 1804, *Porcellio scaber* Latreille, 1804, *Porcellionides pruinosus* (Brandt, 1833), *Proporcellio vulcanius* Verhoeff, 1908;
- Schiziidae: *Paraschizidium coeculum* (Silvestri, 1897);



**Figure 7.1.1.** Taxonomic overview of the Isopoda and Amphipoda species alien *to* and Alien *in* Europe.

- Styloniscidae: *Cordioniscus stebbingi* (Patience, 1907);
- Trachelipidae: *Agabiformius lentus* (Budde-Lund, 1885);
- Trichoniscidae: *Androniscus dentiger* Verhoeff, 1908, *Buddelundiella cataractae* Verhoeff, 1930, *Haplophthalmus danicus* Budde-Lund, 1880, *Metatrachoniscoides leydigi* (Weber, 1880), *Trichoniscus provisorius* Racovitza, 1908, *Trichoniscus pusillus* Brandt, 1833.

Some of the species above have proved to be very successful colonizers and are currently considered as part of the native fauna in parts of Europe, e.g. in Hungary. However, their synanthropic nature and their extremely wide distribution range suggest a long colonisation history as it is the case for *Armadillidium vulgare*.

In the remainder of this chapter, we will focus mainly on the species alien *to* Europe.

### 7.1.3. Temporal trends of introduction in Europe of alien terrestrial crustaceans

The total number of crustaceans alien *to* Europe has slowly increased during the 20<sup>th</sup> and the early 21<sup>st</sup> centuries, but without any acceleration in the rate of arrival. Two alien species were first discovered in Europe in the 19<sup>th</sup> century, about nine species in the first half of the 20<sup>th</sup> century and only five species since then. The majority of these alien species have been found in several other countries after their discovery in Europe. However, the number of occupied countries over time has grown steadily rather than exhibiting exponential growth.

A similar pattern is apparent for woodlice species alien *to* Europe. However, because of sparser information on this group, the date for the first introduction is roughly known for only approximately 50% of species. To our knowledge, at least six species of

woodlice classified as aliens of Europe were noticed in the first half of the 20<sup>th</sup> century and only five more species since then.

Thus, unlike many other invertebrate phyla, the temporal trend in alien crustaceans (both intra-European and alien) has shown no marked changes during recent decades. As “silent invaders” (Hornung et al. 2007) no terrestrial crustaceans are classified as pests in Europe; they are elusive animals. We suspect frequently a large gap between the date of introduction and “discovery” of alien woodlice species. For example, during an intense eight year survey of the isopod fauna in a large region representing 15% of Hungary, three new alien species for this country were found (Farkas 2007).

To conclude, the atypically gradual trend in the number of alien terrestrial Crustacea in Europe could be an artefact of incomplete knowledge. Because of both the increasing worldwide trade in ornamental plants and the general ecology of terrestrial crustaceans (i.e. often hidden in soils), it is more realistic to expect a future exponential increase in the number of alien species (especially intra-European aliens).

#### **7.1.4. Biogeographic patterns of the alien Crustaceans**

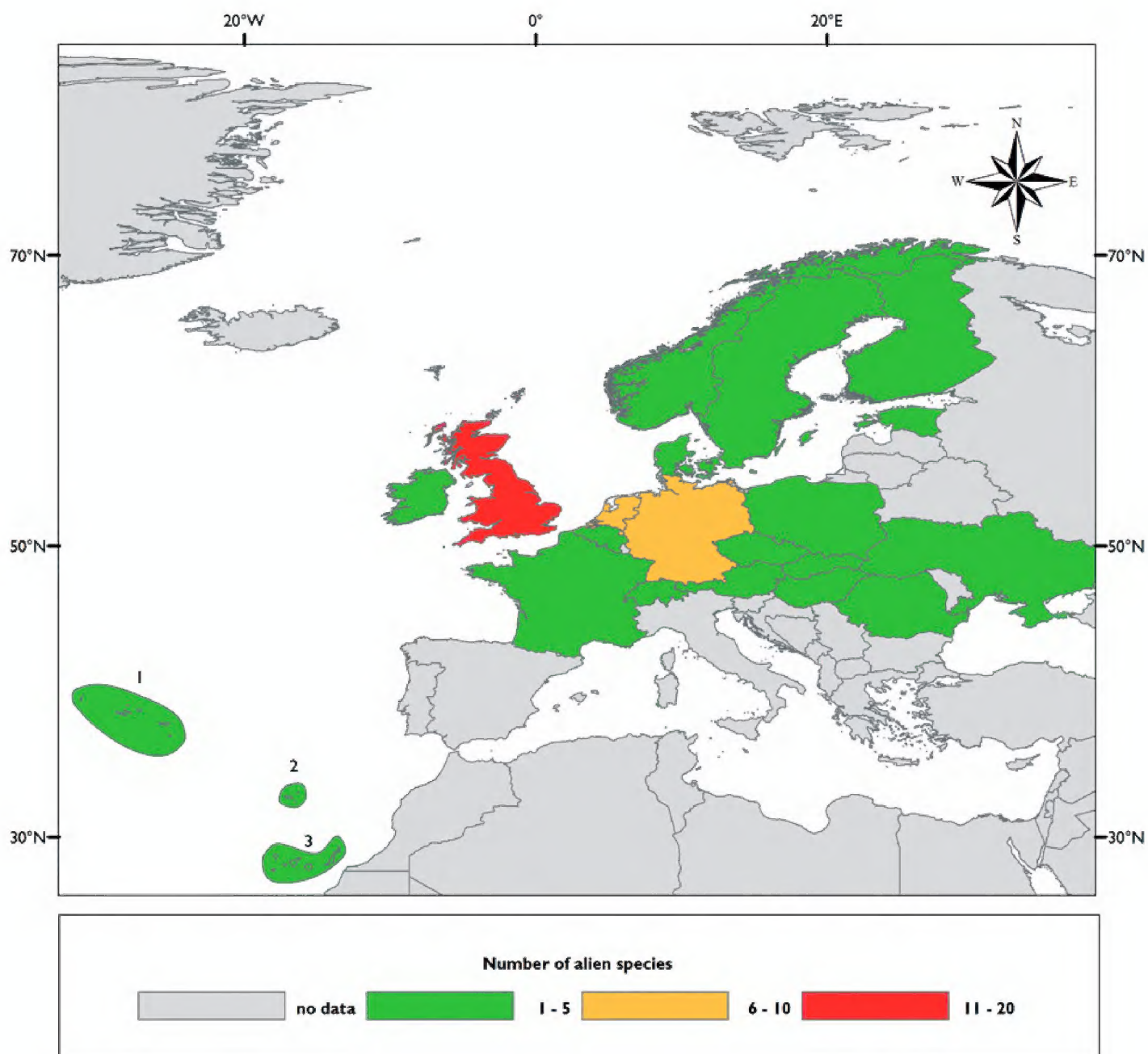
##### ***7.1.4.1. Origin of the alien species***

Species alien to Europe almost all originate from sub-tropical or tropical areas (Table 7.1.1.). Only one species – *Protracheoniscus major* (Dollfus, 1903)- is likely to be native from Central Asia. For several species, their ranges are poorly known (they are also often introduced in other tropical areas). However, several species do have a precise origin. The most widely distributed alien woodlouse in Europe is the tropical American *Trichorhina tomentosa* (Budde-Lund, 1893), while the most widely distributed amphipod is *Talitroides alluaudi* Chrevreux, 1901. It should be noted that a least six of the seventeen alien species were originally described from Europe (Great Britain, France and Germany) after their introduction.

The crustaceans alien in Europe generally originate from the Mediterranean basin (seven species), from western and south-western Europe (five species).

##### ***7.1.4.2 Distribution of the alien species in Europe***

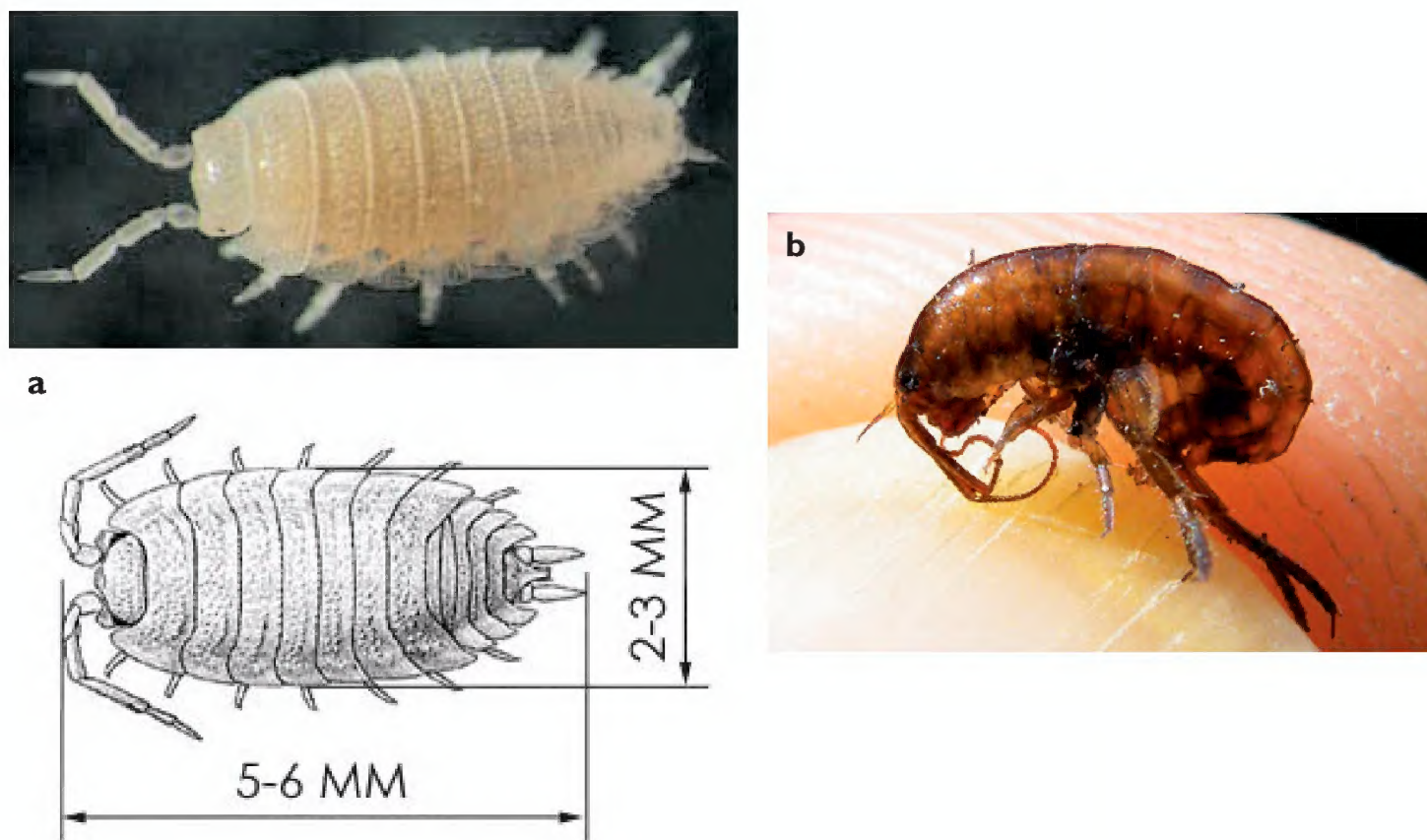
Within Europe, Crustaceans of alien origin have mainly been recorded in western countries, where they appeared first. The four countries with most species are Great Britain (11 species), the Netherlands (10 species) and Germany (nine species) (Figure 7.1.2). Comparatively few alien species have been recorded in central and eastern Europe to date (e.g. only four species in Hungary). In this part of Europe, the Central-Asian *P. major* is one of the most widespread alien crustaceans. The high number of aliens in western European countries may be linked to the high number of scientists and the intensity of soil research (Hornung 2009).



**Figure 7.1.2.** Colonization of continental European countries and main European islands by myriapod species alien to Europe. Archipelago: **1** Azores **2** Madeira **3** Canary islands.

There are only very few records of alien crustaceans on European islands. *Trichoniscus pusillus* has been reported from the Azores and Madeira, *T. provisorius* and *A. assimile* from the Azores but these species are native of Continental Europe. To our knowledge, the only alien aliens recorded on islands are talitrids, *Arcitalitrus dorrieni* (Hunt, 1925) in Scilly and Guernsey, *Talitroides topitotum* (Burt, 1934) in the Azores and Madeira, and *T. alluaudi* in the Azores and the Canaries. All these species occur outdoors and are therefore considered as naturalised. The rarity of alien terrestrial crustaceans on European islands is likely to be due to the primarily introduction route being major greenhouses in large metropolitan cities (see below).

Crustaceans classified as aliens of Europe are typically species which have expanded their range approximately northwards and eastwards. The eastern and central countries have a higher number of these species than more westerly countries of Europe. For example, Germany and the Czech Republic, taken together, have nine species of alien woodlice of European origin, about 45% of the total in this category.



**Figure 7.1.3.** Alien terrestrial crustaceans. **a** *Trichorhina tomentosa* (Isopoda, woodlice) (credit: Vassily Zakhartchenko) **b** *Arcitalitrus dorrieni* (Amphipoda, lawn shrimp) (Credit: John I. Spicer).

A striking example of successful colonization and establishment of such species is given by *A. nasatum*. This woodlouse is believed to be native to Italy, southern France and Spain (Vandel 1962). Since the start of the 20<sup>th</sup> century, it has been introduced into greenhouses in a number of additional countries of Northern and Central Europe (e.g. Denmark, Finland, Germany, Hungary, Poland, Slovakia, Sweden), making this species one of the most widely distributed alien woodlice of Europe. Moreover, numerous reports highlight the successful establishment of outdoor populations in several western and central European countries (e.g. the Netherlands, Czech Republic, Romania, Slovenia) (Berg et al. 2008, Giurginca 2006, Navrátil 2007, Vilisics and Lapanje 2005).

Some of the aliens of Europe have also invaded other continents and can be considered as very successful invaders. The most notable ones are *A. vulgare*, *P. scaber* and *P. pruinosus*. *Armadillidium vulgare* and *P. pruinosus* are probably native from Mediterranean regions. In northern temperate parts of Europe, these species are restricted to synanthropic habitats (e.g. gardens, cellars, compost heaps). *P. pruinosus* is one of the woodlice that has been spread most by man across the world (Vandel 1962) and can now be considered as “synanthropically cosmopolitan” (Schmalfuss 2003).

A consequence of the dominance of Mediterranean origin for species classified as aliens of Europe is their decreasing number towards the north of the continent (Vilisics et al. 2007). In the northernmost countries of Europe (e.g. Finland (Vilisics and Terhivuo 2009)) only the most tolerant habitat-generalists, as well as intra-European aliens, are able to become successfully established.

### 7.1.5. Pathways of introduction of alien terrestrial Crustaceans

Because a great majority of the first isopod introductions were recorded in greenhouses, botanical gardens or urban parks, it is clear that many were associated with passive transport of soil, plants or compost. With few visible effects in such biotopes, terrestrial crustaceans colonize and spread as undetected “silent invaders” (Hornung et al. 2007). Thus, most introductions were unintentional. The one known exception is the spreading of *T. tomentosa*, commonly sold as pet food, triggered by trading activity in Europe. This probably explains why, among all the alien crustaceans, *T. tomentosa* is the most widespread species in Europe.

Another interesting case is the Mediterranean species *P. schoblii*. This myrmecophilous woodlouse is a commensal of the ant *Lasius neglectus* Van Loon, Boomsma & Andrásfalvy, 1990 and was first recorded in Hungary in 2001, a few years after the introduction of the ant. *P. schoblii* was probably introduced at the same time as its ant host (Tartally et al. 2004). It has since been found regularly (Hornung et al. 2005, Tartally et al. 2004, Vilisics 2007, Vilisics et al. 2007) and is now considered established, as is *L. neglectus*.

### 7.1.6 Ecosystems and habitats invaded in Europe by alien terrestrial Crustaceans

To our knowledge, the only alien crustaceans invading natural habitats are three talitrid species. *Arcitalitrus dorrieni* has invaded leaf litter understoreys of deciduous woodlands in Great Britain and Ireland (Cowling et al. 2003, Vader 1972). *Talitroides alluaudi* is known outdoors in the Canary Islands, and *T. topitotum* in the Madeira Islands, both species in the Azores (Vader 1972). All other species are generally limited to highly artificial habitats and artificial ecosystems: mostly greenhouses, urban parks and houses (especially cellars). The proportion of introduced isopods can be very high in urban areas. A study in Budapest revealed that 35% of the total species (n = 28) were introduced (Vilisics and Hornung 2009). The major settlements of Hungary were characterised as “hotspot for non-native species” (Hornung et al. 2008). This could certainly be applied to many major cities in other European countries.

For the tropical species, especially those recorded only once or twice in Europe, they may not be considered as established (Table 7.1.1.) since their survival is completely dependent on warm greenhouses.

Among all alien woodlice, none have spread to more natural habitats. However, the situation is different for intra-European woodlice native to southern or Mediterranean Europe. These established aliens can successfully expand by dispersal from very disturbed areas (where they were originally introduced) to more semi-natural habitats in rural-suburban zones (Vilisics and Hornung 2009). With global warming and the large-scale disturbance of biomes in Europe, that trend could increase, especially for the species with large ecological spectra.

### 7.1.7. Ecological and economic impact of alien terrestrial Crustaceans

Alien crustaceans in Europe are not known to carry diseases or to have an impact on native species and natural habitats. Further, they have no economical impact. Based on existing literature, the occurrence of alien woodlice is strictly bound to the urban environment (e.g. greenhouses, botanical and private gardens); alien terrestrial isopods do not yet seem able to survive or to expand to more natural ecosystems.

The case of the alien amphipod *A. dorrieni* is quite different. Terrestrial amphipods are known to have many effects on the soil and leaf litter (Friend and Richardson 1986). *Arcitalitrus dorrieni* has invaded deciduous and coniferous woodlands in western parts of Great Britain. In Ireland, a study showed that 24.7% of annual litter fall in a coniferous woodland was ingested by this species. It is suggested that “this introduced species plays a more important role than native macrofaunal species in nutrient turnover in this particular woodland habitat” (O’Hanlon and Bolger 1999). It is possible that other, as yet undetected, ecological impacts are likely.

Terrestrial crustaceans can represent a large percentage of biomass and abundance in the soil macrofauna (Gongalsky et al. 2005). Thus any successful invasion by a terrestrial alien crustacean could induce some disturbance if it established in relatively natural habitats. For example, in a forested area of Florida, a study on the introduced European woodlouse *A. vulgare* showed that this species’ activity “had a strong effect on the chemistry of the mineral layer” (Frouz et al. 2008) and concluded that in some cases it may significantly alter soil conditions”.

Woodlice classified as aliens of Europe are usually associated with synanthropic habitats and often gain dominance in urban environments (e.g. urban parks, villages, private gardens). The successful colonisation of human-influenced biotopes may lead to the uniformity of local Isopod assemblages. With the decrease of native species in the urban isopod fauna, an ongoing process of biotic homogenisation is prevalent in cities across Europe (Szlávecz et al. 2008, Vilisics and Hornung 2009).

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## References

- Allspach A (1992) Die Landasseln (Crustacea: Isopoda: Oniscidea) Hessens. *Naturschutz heute* 12: 1–146.
- Berg MP, Soesbergen M, Tempelman D, Wijnhoven H (2008) *Verspreidingsatlas Nederlandse landpissebedden, duizendpoten en miljoenpoten (Isopoda, Chilopoda, Diplopoda)*. European Invertebrate Survey. Amsterdam: Nederland Vrije Universiteit, Afdeling Dierecologie.
- Calman WT (1912) On a terrestrial amphipod from Kew Gardens. *Annals and Magazine of Natural History* 8: 132–137.
- Chevreaux E (1896) Recherches zoologiques dans les serres du Museum de Paris. sur un amphipode terrestre exotique, *Talitrus alluaudi* nov. sp., acclimate dans les serres du Jardin des Plantes de Paris. *Feuille des jeunes naturalistes* 3: 112–113.
- Cowling JE, Spicer JI, Weeks JM, Gaston KJ (2003) Environmental tolerances of an invasive terrestrial amphipod, *Arcitalitrus dorrieni* (Hunt) in Britain. *Comparative Biochemistry and Physiology Part A* 136: 735–747.
- Cowling JE, Spicer JI, Gaston KJ, Weeks JM (2004) Current status of an amphipod invader, *Arcitalitrus dorrieni* (Hunt, 1925), in Britain. *Journal of natural history* 38: 1665–1675.
- Cowling JE, Weeks, Spicer JI, Gaston KJ (2004) Physiological tolerances of the euterrestrial amphipod *Arcitalitrus dorrieni* (Hunt) as a key to its geographical distribution? A test using mesocosms. *Comparative Biochemistry and Physiology, Part A* 139: 251–259.
- Dollfus A (1896a) Recherches zoologiques dans les serres du Muséum de Paris. *Feuille des jeunes naturalistes* 30: 90–94.
- Dollfus A (1896b) On West-Indian terrestrial Isopod Crustaceans. *Proceedings of the General Meetings for Scientific Business of the Zoological Society of London for the year 1896*: 388–400.
- Dudich E (1926) Trópusi rák Budapesten. *Természettudományi Közlöny*, 58: 293–295.
- Dudich E (1933) Faunisztikai jegyzetek (Faunistiche Notizen) IV. *Állattani Közlemények* 30: 120–129.
- Dydych T (1903) Materialien zu einer Isopodenfauna Galiziens. *Bulletin international de l'Académie des Sciences et des Lettres de Cracovie*: 61–64.
- Dominiak B (1970) Badania nad równonogami Polski. *Fragmenta faunistica (Warsaw)* 15: 401–472.
- Edney E (1953) The woodlice of Great Britain and Ireland. A concise systematic monograph. *Proceedings of the Linnean Society London* 164: 49–98.
- Farkas S (2007) The terrestrial isopod fauna of South Transdanubia (Hungary). *Somogyi Múzeumok Közleményei. B - Természettudomány* 17: 159–168.
- Fasulo TR (2008) Terrestrial Amphipods or “Lawn Shrimp” (Crustacea: Amphipoda). University of Florida, Featured Creatures Website. <http://creatures.ifas.ufl.edu> [accessed July 2001, revised 2008].
- Ferrara F, Taiti S (1982) A new Philosciid from eastern Africa (Crustacea, Oniscoidea). *Revue Suisse de zoologie* 89: 439–442.
- Flasarová M (1986) Isopoda (Asellota, Oniscoidea) of the Little Carpathians. In: Nosek J (Ed) *The Soil Fauna of the Little Carpathians*, Bratislava, 183–216.

- Flasarová M (1988) Zur Kenntnis der Isopoden Mittelböhmens (Crustacea, Isopoda, Asellota et Oniscidea). *Faunistische Abhandlungen (Dresden)* 15: 119–130.
- Flasarová M (1995) Die isopoden Nordwestböhmens (crustacea: Isopoda: Asellota et oniscidea). *Acta Scientiarum naturalium (Brno)* 29: 1–156.
- Forró L, Farkas S (1998) Checklist, preliminary distribution maps, and bibliography of woodlice in Hungary (Isopoda: Oniscidea). *Miscellanea Zoologica Hungarica* 12: 21–44.
- Foster NH (1911) On two alien species of woodlice found in Ireland. *The Irish Naturalist* 20: 154–156.
- Foster NH, Pack-Beresford DR (1913) Additions to the distributional records of woodlice in Ireland. *The Irish Naturalist* 22: 45–48.
- Frankenberger Z (1959) *Fauna ČSR, Svazek 14. Stejnonožci suchozemští - Oniscoidea*. Praha: NČSAV.
- Friend JA, Richardson AMM (1986) Biology of terrestrial Amphipods. *Annual Review of Entomology*, 31: 25–48.
- Frouz J, Lobinske R, Kalčík J, Arshad A (2008) Effect of the alien crustacean, *Armadillidium vulgare* (Isopoda), and other macrofauna on organic matter dynamics in soil microcosms in a hardwood forest in central Florida. *Florida entomologist* 91: 328–331.
- Giurginca A (2006) On some Oniscidea and Diplopoda from Bucharest, Romania. *Archives of Biological Sciences, Belgrade* 58: 31–35.
- Gongalsky KB, Savin FA, Pokarzhevskii AD, Filimonova ZV (2005) Spatial distribution of isopods in an oak-beech forest. *European Journal of Soil Biology* 41: 117–122.
- Grüner H (1966) Über *Protracheoniscus asiaticus* (Uljanin, 1875) und die verwandten Arten (Isopoda, Oniscoidea). *Mitteilungen des zoologischen Museums Berlin* 42: 307–319.
- Gregory S (2009) *Woodlice and Waterlice (Isopoda: Oniscidea & Asellota) in Britain and Ireland*. Centre for Ecology & Hydrology. 175 pp.
- Harding PT, Sutton SL (1985) *Woodlice in Britain and Ireland: distribution and habitat*. Huntingdon, UK: Institute of terrestrial ecology, Natural environment research Council. 151 pp.
- Hassall M, Turner J, Rands M (1987) Effects of terrestrial isopods on the decomposition of woodland leaf litter. *Oecologia (Berlin)* 72: 597–604.
- Holthuis LB (1945) Notes on terrestrial isopoda collected in Dutch greenhouses. *Zoologische Mededeelingen* 25: 43–54.
- Holthuis LB (1947) On a small collection of isopod Crustacea from the greenhouses of the Royal Botanic Gardens, Kew. *Annals and Magazine of natural History*, Series 11, 13: 122–137.
- Holthuis LB (1956) *Fauna van Nederland 16. Isopoda en Tanaidacea*. 16. Leiden, The Netherlands: AW Sijthoff's Uitgeversmaatschappij N.V. 280 pp.
- Hornung E, Vilisics F, Sólymos P (2008) Low alpha and high beta diversity in terrestrial isopod assemblages in the Transdanubian region of Hungary. In: Zimmer M, Cheikrouha C, Taiti S (Eds) *Proceedings of the International Symposium of Terrestrial Isopod Biology*, 1–11.
- Hornung E, Vilisics F, Tartally A (2005) Occurrence of *Platyarthrus schoblii* (Isopoda, Oniscidea) and its ant hosts in Hungary. *European Journal of Soil Biology* 41: 129–133.

- Hornung E, Vilisics F, Szlávecz K (2007) Hazai szárazföldi ászkarákfajok (Isopoda, Oniscidea) tipizálása két nagyváros, Budapest és Baltimore (ÉK Amerika) összehasonlításának példájával. *Természetvédelmi Közlemények*, 13: 47–58.
- Hornung E (2009) personal communication.
- Hunt OD (1925) On the amphipod genus *Talitrus*, with a description of a new species from the Scilly Isles, *T. dorrieni* n. sp. *Journal of the Marine Biological Association of the United Kingdom* 13: 854–869.
- Ilosvay G (1985) On the isopod, diplopod and chilopod fauna of the Zirc arboretum. *A Bakony természettudományi kutatásának eredményei* 16: 43–50.
- Jędrzycki W (1979) Synanthrope landisopoden (isopoda, oniscoidea) polens. *Fragmenta faunistica (Warsaw)* 25: 95–106.
- Kesselyák A (1930a) Über isopoden. *Zoologischer Anzeiger* 91: 50–66.
- Kesselyák A (1930b) Faunistisches über Isopoden. *Zoologische Jahrbucher, Abteilung für Systematik, Ökologie und Geographie der Tiere* 60: 239–256.
- Kontschán K (2004) Magyarország faunájára új ászkarák (*Reductoniscus constulatus* Kesselyák, 1930- Crustacea: Isopoda: Oniscidea) előkerülése az ELTE füvészkertjéből (Budapest). *Folia Historico Naturalia Musei Matraensis* 28: 89–90.
- Korsós Z, Hornung E, Szlávecz K, Kontschán J (2002) Isopoda and Diplopoda of urban habitats: new data to the fauna of Budapest. *Annales Historico-Naturales Musei Nationalis Hungarici* 94: 193–208.
- Meinertz T (1934) Die Landisopoden Danemarks. II. Die Onisciden. *Zoologische Jahrbucher, Abteilung für Systematik, Ökologie und Geographie der Tiere* 66: 211–284.
- Moore PG, Spicer JI (1986) On the status of *Arcitalitrus dorrieni* (Crustacea: Amphipoda) on the island of Colonsay, Inner Hebrides. *Journal of Natural History* 20: 667–680.
- Navrátil M (2007) Stonožky, mnohonožky a suchozemští stejnonožci ve městě (Olomouc, Hodonín). Master's thesis, Univerzita Palackého v Olomouci.
- Oliver PG, Meehan C (1993) *Woodlice*. Number 49 in Synopses of the British Fauna (N. S.). London: The Linnean Society of London.
- Olsen KM (1995) *Cordioniscus stebbingi* (Patience, 1907) and *Trichorhina tomentosa* (Budde-Lund, 1893), two greenhouse woodlice (Isopoda, Oniscidea) new to Norway. *Fauna Norvegica Ser B* 42: 67.
- O'Hanlon RP, Bolger T (1999) The importance of *Arcitalitrus dorrieni* (Hunt) (Crustacea: Amphipoda: Talitridae) in coniferous litter breakdown. *Applied soil ecology* 11: 29–33.
- Pack-Beresford D, Foster N (1911) The woodlice of Ireland. Their distribution and classification. *Proceedings of the Royal Irish Academy* 29: 165–189.
- Patience A (1907) On a new British terrestrial isopod. *Annals of Scottish natural History* 62: 85–88.
- Patience A (1908) On a new British terrestrial isopod (*Trichoniscus linearis* sp. n.). *Annals and Magazine of Natural History* 8: 280–282.
- Peart R, Lowry JK (2006) The amphipod genus *Arcitalitrus* (Crustacea: Amphipoda: Talitridae) of New South Wales forests, with descriptions of six new species. *Records of the Australian Museum* 58: 97–118.

- Polk P (1959) Notes sur la distribution et la bibliographie des Oniscoidea de la Belgique. *Biologisch Jaarboek (Antwerpen)* 27: 452–460.
- Radu VG (1960) Specii de losciide (izopode terestre) in fauna Republicii Populare Romine. *Studii și Cercetări de Biologie. Academia Republicii Populare Romine, Filiala Cluj* 11: 269–275.
- Schmalfuss H (2003) World catalog of terrestrial isopods (Isopoda: Oniscidea). *Stuttgarter Beiträge zur Naturkunde serie A* 654: 341. Revised and updated version. [http://www.oniscidea-catalog.naturkundemuseum-bw.de/Cat\\_terr\\_isop.pdf](http://www.oniscidea-catalog.naturkundemuseum-bw.de/Cat_terr_isop.pdf).
- Schmölzer K (1974) *Catalogus Faunae Austriae, Teil 8e, Isopoda*. Vienna, pp. 1–16.
- Semenkevitch J (1931) Isopoda terrestria der Umgegend von Kiew. *Mémoires de la Classe des Sciences naturelles et techniques de l'Académie des Sciences d'Ukraine* 5: 3–16.
- Spicer JL, Tabel H (1996) Notes on the occurrence of the introduced landhopper *Arcitalitrus dorrieni* (Hunt, 1925) on Guernsey, Channel Islands. *Journal of natural history* 30: 1625–1632.
- Soesbergen S (2003) *Venezillo parvus* en *Synarmadillo* spec., twee nieuwe landpissebedden in Nederland (Crustacea: Isopoda: Armadillidae). *Nederlandse faunistische Mededelingen* 18: 97–101.
- Soesbergen M (2005) En de naam is... *Synarmadillo pallidus* (Crustacea: Isopoda: Armadillidae). *Nederlandse faunistische Mededelingen* 22: 123–126.
- Stock JH, Biernbaum CK (1994) Terrestrial Amphipoda (Talitridae) from Ascension and Saint Helena (South Central Atlantic). *Journal of natural history* 28: 795–811.
- Strouhal H (1929) Über einige Arten der Gattung *Protracheoniscus* Verh. (Isop. terr.). *Annalen des naturhistorischen Museums in Wien* 43: 1–12.
- Strouhal H (1951) Die österreichischen Landisopoden, ihre Herkunft und ihre Beziehungen zu den Nachbarländern. *Verhandlungen der zoologisch-botanischen Gesellschaft Wien* 92: 116–142.
- Sutton SL (1980) *Woodlice*. New York: Pergamon Press. 144 pp.
- Szlávecz K, Csuzdi C, Korsós Z, Hornung E, Vilisics F (2008) *Earthworms, Isopods and Millipedes on the urban landscape: Patterns in European and American cities*. In: Book of Abstracts of the 3rd Conference of the Competence Network Urban Ecology 'Urban Biodiversity and Design', Erfurt, Germany. May 2008, 234.
- Tartally A, Hornung E, Espadaler X (2004) The joint introduction of *Platyarthrus schoblii* (Isopoda: Oniscidea) and *Lasius neglectus* (Hymenoptera: Formicidae) into Hungary. *Myrmecologische Nachrichten* 6: 61–66.
- Uteseny K (Taiti S. det.) (2009) Unpublished record.
- Vader W (1972) Terrestrial Amphipoda collected in greenhouses in the Netherlands. *Zoologische Bijdragen* 13: 32–36.
- Vandel A (1960) *Faune de France* 64. *Isopodes terrestres (première partie)*. Paris : Fédération Française des Sociétés de Sciences Naturelles.
- Vandel A (1962) *Faune de France* 66. *Isopodes terrestres (deuxième partie)*. Paris : Fédération Française des Sociétés de Sciences Naturelles.
- Verhoeff K (1928) Über stenonisciden. *Zoologischer Anzeiger* 79: 58–64.
- Verhoeff K (1930) Zur Kenntnis osteuropäischer Isopoden. *Zoologische Jahrbucher. Abteilung für Systematik, Ökologie und Geographie der Tiere* 59: 1–64.

- Verhoeff K (1937) Über einige neue und bekannte isopoda terrestria. *Sitzungsberichte der Gesellschaft Naturforschender Freunde zu Berlin* 1937: 411–430.
- Vilisics F (2007) New and rare species in the isopod fauna of Hungary (Crustacea, Isopoda, Oniscidea): results of eld surveys and revisions. *Folia Historico-naturalia Musei Matraensis* 31: 115–123.
- Vilisics F, Elek Z, Lövei GL, Hornung E (2007) Composition of terrestrial isopod assemblages along an urbanisation gradient in Denmark. *Pedobiologia* 51: 45–53.
- Vilisics F, Hornung E (2009) Urban areas as hot-spots for introduced and shelters for native isopod species. *Urban ecosystems* 12: 333–345.
- Vilisics F, Lapanje A (2005) Terrestrial isopods (Isopoda: Oniscidea) from the Slovenian karst. *Natura Sloveniae*, 71: 13–21.
- Vilisics F, Sólymos P, Hornung E (2007) A preliminary study on habitat features and associated terrestrial isopod species. In: Tajovský K, Schlaghamerský J, Pižl V (Eds) *Contributions to Soil Zoology in Central Europe II*. České Budějovice: Institute of Soil Biology, Biology Centre, Academy of Sciences of the Czech Republic, 195–199.
- Vilisics F, Terhivuo J (2009) Inspection on materials contributing to the knowledge of terrestrial Isopoda (Crustacea, Oniscidea) in Finland. *Memoranda Societatis pro Fauna et Flora Fennica* 85: 9–15.
- Wouters K, Tavernier JM, Meurisse L (2000) Distribution and bibliography of the terrestrial Isopoda (Crustacea) of Belgium. *Bulletin de l'Institut Royal des Sciences Naturelles de Belgique* 70: 195–205.
- Zimmer M (2002) Nutrition in terrestrial isopods (Crustacea: Isopoda): an evolutionary-ecological approach. *Biological Reviews* 77: 455–493.

**Table 7.1.1.** List and main characteristics of the Crustacean species alien to Europe. Country codes abbreviations refer to ISO 3166 (see appendix I). Habitat abbreviations refer to EUNIS (see appendix II). Only selected references are given. Last update 16/10/2009.

Order <i>Family</i>	<i>Species</i>	Regime	Native range	1st record in Europe	Invaded countries	Habitat	References
<b>Isopoda</b>							
<i>Agnaridae</i>							
	<i>Protracheoniscus major</i> (Dollfus, 1903)	Detritivorous	Central Asia?	1903, PL/ UA	AT, CZ, DE, EE, HU, PL, RO, SK, UA	J	Dudich (1926), Dudich (1933), Dyduch (1903), Dominiak (1970), Flasarová (1986), Flasarová (1988), Flasarová (1995), Forró and Farkas (1998), Frankenberger (1959), Ilosvay (1985), Schmölzer (1974), Semenkevitch (1931), Strouhal (1929), Strouhal (1951), Verhoeff (1930)
<b>Isopoda</b>							
<i>Armadillidae</i>							
	<i>Reductoniscus costulatus</i> Kesselyák, 1930	Detritivorous	Pacific islands	1930, DE	DE, FR, GB, HU, NL	J	Berg et al. (2008), Grüner (1966), Holthuis (1947), Holthuis (1956), Kesselyák (1930a), Kesselyák (1930b), Kotschán (2004), Schmalfuss (2003), Soesbergen (2003), Vandel (1962), Verhoeff (1937)
	<i>Synarmadillo pallidus</i> Arcangeli, 1950	Detritivorous	Congo	2003, NL	NL	J	Berg et al. (2008), Schmalfuss (2003), Soesbergen (2003), Soesbergen (2005)
	<i>Venezillo parvus</i> (Budde-Lund, 1885)	Detritivorous	Tropical regions	2003, NL	GB, NL	J	Berg et al. (2008), Gregory (2009), Schmalfuss (2003), Soesbergen (2003)
<b>Isopoda</b>							
<i>Philosciidae</i>							
	<i>Anchiphiloscia balssi</i> (Verhoeff, 28)	Detritivorous	East Africa	1928, DE	DE, NL	J	Berg et al. (2008), Ferrara and Taiti (1982), Holthuis (1945), Schmalfuss (2003), Verhoeff (1928)
	<i>Benthana olfersii</i> (Brandt, 1833)	Detritivorous	Brazil (Southeast)	?, DE	DE	J	Schmalfuss (2003)
	<i>Burmoniscus meeusei</i> (Holthuis, 1947)	Detritivorous	Asia	1947, GB	GB	J	Harding and Sutton (1985), Holthuis (1947)

Order <i>Family</i>	<i>Species</i>	Regime	Native range	1st record in Europe	Invaded countries	Habitat	References
	<i>Burmoniscus orientalis</i> Green, Ferrara & Taiti, 1990	Detritivorous	Asia	2005, AT	AT	J	Uteseny (2009)
<b>Isopoda</b>							
<i>Platyarthridae</i>							
	<i>Trichorhina tomentosa</i> (Budde-Lund, 1893)	Detritivorous	America (Tropical)	1896, FR	AT, CH, BE, CH, CZ, DE, FR, GB, HU, IE, NL, NO, PL <sup>1</sup>	J	Berg et al. (2008), Dollfus (1896a), Foster (1911), Foster and Pack-Beresford (1913), Harding and Sutton (1985), Holthuis (1945), Jedryckowsky (1979), Korsós et al. (2002), Meinertz (1934), Olsen (1995), Pack-Beresford and Foster (1911), Polk (1959), Schmalfluss (2003), Verhoeff (1937), Wouters et al. (2000)
<b>Isopoda</b>							
<i>Styloniscidae</i>							
	<i>Styloniscus spinosus</i> (Patience, 1907)	Detritivorous	Madagascar, Mauritius	1907, GB	GB	J	Edney (1953), Harding and Sutton (1985), Patience (1907), Schmalfluss (2003)
<b>Isopoda</b>							
<i>Trachelipodidae</i>							
	<i>Nagurus cristatus</i> (Dollfus, 1889)	Detritivorous	Pantropical	1956, NL	DE, GB, NL, RO	J	Allspach (1992), Berg et al. (2008), Harding and Sutton (1985), Holthuis (1956), Oliver and Meechan (1993), Radu (1960), Schmalfluss (2003)
	<i>Nagurus nanus</i> Budde-Lund, 1908	Detritivorous	Tropical regions	1985 GB	GB, IE	J	Foster (1911), Foster and Pack-Beresford (1913), Harding and Sutton (1985), Schmalfluss (2003), Sutton (1980)
<b>Isopoda</b>							
<i>Trichoniscidae</i>							
	<i>Miktoniscus linearis</i> (Patience, 1908)	Detritivorous	USA (East) ?	1908, GB	DE, GB	J	Kesselyák (1930a), Patience (1908), Schmalfluss (2003), Vandel (1962)

Order Family	Species	Regime	Native range	1st record in Europe	Invaded countries	Habitat	References
Amphipoda							
Talitridae							
	<i>Arcitalitrus dorrieni</i> (Hunt, 1925)	Detritivorous	Australia (East)	1925, GB	GB, IE, NL	G1, J	Cowling et al. (2003), Cowling et al. (2004a), Cowling et al. (2004b), Hunt (1925), Moore and Spicer (1986), Peart and Lowry (2006), Spicer and Tabel (1996)
	<i>Brevitalitrus hortulanus</i> Calman, 1912	Detritivorous	Tropical regions?	1912, GB	GB, NL	J	Calman (1912), Friend and Richardson 1986, Vader (1972)
	<i>Talitroides alluaudi</i> (Chevreux, 1896)	Detritivorous	Tropical regions, Seychelles Isl.?	1896, FR	BE, CH, CZ, DE, DK, ES- CAN, FI, FR, GB, HU, NL, PL, PT- AZO, SE	G1, J	Chevreux (1896), Dudich (1926), Friend and Richardson (1986), Hunt (1925), Vader (1972)
	<i>Talitroides topitotum</i> (Burt, 1934)	Detritivorous	Indo-Pacific	1942, DE	DE, GB, NL, PT-AZO, PT-MAD	G, J	Friend and Richardson (1986), Stock and Biernbaum (1994), Vader (1972)

1 *Trichorhina tomentosa* is on sale as reptile food in many European pet shops.  
After this table was established, Gregory (2009) mentioned the presence of two more alien species in Great Britain, *Styloniscus mauritiensis* (Barnard, 1936) (Stylo-  
niscidae) from Hawaii and Mauritius and *Setaphora patiencei* (Bagnall, 1908) (Philosciidae) from The Réunion and Mauritius islands.